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(54) Method for channel change in digital radiocommunication system

(57) Method for the change of a radio bearer in a digital telecommunication system comprising a radio-mobile unit (PP) and a fixed unit (RFP) connected between them on at least a bearer in the following, labeled with X. When a radio unit (PP or RFP) detects a bad connection quality on bearer X between said radio-mobile unit (PP) and fixed unit (RFP), the method applies with the execution in sequence of the following steps:

a) listening of a new frequency on at least one of the time slots used in reception with the purpose to identify a second not interfered bearer, in the following, labelled with Y;
b) sending from the requiring radio unit to the interacting radio unit a message requiring the activation of the said second bearer (Y);
c) transferring of all communications between both radio units from the first bearer X to the second bearer Y as soon as the requiring radio unit receives a specific confirmation message by the interactive radio unit;
d) return to the listening step if the confirmation message is not received.

The invention has the advantage of enabling the handover of a radio bearer changing only the frequency, but maintaining the same transceiving time slots without the need of an additional time slot which, in this way, is available for new communications.

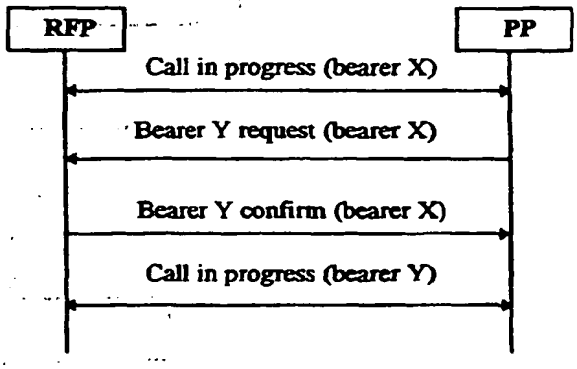

Fig. 5

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Description

Technical Field

[0001] The present invention relates to the digital telecommunication systems with time division access technique, TDMA (Time Division Multiple Access), and in particular, but not exclusively, systems according to the DECT (Digital Enhanced Cordless Telecommunications) technology.

[0002] More precisely the invention is addressed to the change modalities of the so-called bearer (indicated hereafter with equivalent signification by the term "radio channel") defined by the couple time slot/frequency through which the connection between two transceiver units (one mobile unit PP (Portable Part) and a fixed unit RFP (Radio Fixed Part) occurs.

[0003] As already known, in a DECT system, the transmission and reception of the signals between both radio units, mobile (Portable Part (PP)) and fixed (Radio Fixed Part (RFP)) is arranged in frames. The frame is divided in 2 half frames: normally, the first half frame is used in the fixed to mobile direction (downlink direction) and the second one is used in the mobile to fixed direction (uplink direction). As depicted in Fig. 1, every half frame is subdivided in 12 full type time slots, inside of which the rice-transmission of the useful signal occurs according to the TDMA technique. Inside a specific time slot the ricetransmission of a signal uses one of the 10 carriers/radio frequencies allocated into the band (1800 - 1900 MHz) assigned to the DECT systems.

[0004] For connections of the duplex type, used for example for phone calls, the transmission and the reception channels of a radio unit (the reception and the transmission channels of the other interactive radio unit, respectively) use the same radio carrier and half frame spaced time slots. Fig. 2 shows an example of assignment of time slots for a phone call, (according to DECT terminology, a full duplex bearer).

[0005] In the systems according to the DECT standard also asymmetric connections are defined, preferably used for data transmission. An asymmetric connection may be set up by one (or more) duplex bearers (i.e. a pair of full slots spaced out by half a frame with an opposite direction and the same radio carrier) and/or simplex bearers (i.e. a pair of full slots spaced out by half a frame with the same transmission direction and the same radio carrier).

[0006] Fig. 3 shows an example of frame occupation by one asymmetric downlink connection based on one double simplex bearer and one duplex bearer.

[0007] As already said the time slot/frequency pair defines the radio bearer (or radio channel).

[0008] When the quality perceived on the used channel turns out to be deteriorated, changes of the radio bearer on which the connection is established may occur (bearer handover)

[0009] In the DECT systems different mechanisms are foreseen to check the quality of a communication channel and the transmission quality information obtained may be used by a radio unit to start off a procedure for the change of the bearer (handover) inside the same cell (intracell handover) or towards a new cell (intercell handover).

[0010] In the DECT standard procedures have been defined (i.e. handover) for the change of a radio channel inside a cell or between different cells, if these ones belong to the same cell cluster. The term cluster indicates precisely a unit of cells among which it is possible to carry out the procedure of bearer handover.

[0011] The procedure of bearer handover defines therefore the establishment of a new radio bearer for the replacement of the already established one on which a poor connection quality has been perceived.

Background Art

[0012] EP-A-576 079 discloses a digital telecommunication system in which, during the bearer handover procedure, for a limited period of time, both bearers (the one to be replaced and the new one) coexist and transport the same information.

[0013] The two bearers have to be allocated in different time slots, exception made if the two interacting radio units can use a double transceiver. In fact, when both interactive radio units have a single transceiver, it is necessary that the new requested channel occupy at least a different (from the one in which the old bearer is fitted) and additional time slot (furthermore, possibly a new radio carrier)

[0014] The known procedure presents therefore the drawback that it requires the use of two bearers for the transportation of a unique payload, so rendering not available to the system a bearer that hence cannot be assigned to a user forwarding a connection request during the period of time in which both bearers are active.

Object of the invention

[0015] It is one object of the present invention to overcome the above-mentioned drawbacks and limitations and, in particular, to realise a method for the change of a radio bearer that, respecting the rules of channel allocation imposed by the reference standard, will conserve the same time slot and modify only the radio carrier without requiring the use - even only temporary - of an additional time slot in this way indeed available for new communications.

Summary of the Invention

[0016] According to the method proposed by the invention only the frequency of the bearer will be changed but conserving the same transmission and reception time slots.

[0017] This turns out to be especially advantageous in

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those cases where inside the cell (or the cluster) the number of active traffic channels is high (and consequently the number of available time slots is extremely reduced) and in particular when the bearer to be changed occupies two time slots of the full type: in other words it is a double slot.

[0018] The invention achieves these scopes by means of a method having the characteristics exposed in claim 1.

[0019] The features of the present invention which are believed to be novel are set forth with particularity in the appended claims.

Brief description of the drawings

[0020] The invention, together with further objects and advantages thereof, may be understood with reference to the following description, taken in conjunction with the accompanying drawings, and in which:

Fig. 1 (already described) illustrates the structure of the DECT frame;
Fig. 2 (already described) shows an example of time slot occupation for a full duplex connection;
Fig. 3 (already described) shows an example of frame occupation by an asymmetric downlink connection;
Fig. 4 shows a frame occupation example during the procedure of intracell handover of a double slot, as defined by the ETSI standard;
Fig. 5 illustrates a message exchange - according to the invention - for the switching from the duplex bearer X into the duplex bearer Y required by PP. The example reports the case in which the confirmation message of the new bearer will be transported on the old bearer; and
Fig. 6 illustrates a message exchange - according to the invention - on the duplex bearer Z for the switching of the duplex (double simplex) bearer X in the duplex (double simplex) bearer Y, requested by RFP.

Detailed Description of possible Embodiments of the Method the present Invention is based on

[0021] As previously indicated, the radio bearer changes may happen when the quality perceived on the used channel is deteriorated. The new chosen bearer must be the less interfered of a filled in table of channels, appropriately updated by the radio unit operating the choice, and it must not belong to the group of bearers or channels judged as interfered (busy channels).

[0022] The list of channels will be splitted in bands of detected power, RSSI (Received Signal Strength Interference), with width less than 6 dB. In particular, the channels with an RSSI measure lower than the minimum value are considered to be "quiet" and may be selected immediately, while the channels with a RSSI measure higher than a maximum value are considered as "busy" and they cannot be selected. The channels with an RSSI measure within the minimum and the maximum limits are ordered on the basis of the band they belong to.

[0023] When a bad quality of the connection is perceived, the radio unit, on one or both time slots of the bearer in use, (denoted as bearer X) will start listening a new frequency (for example the most distant one from the used one in the assigned band). If the new listened channel, called for convenience bearer Y, is not a "busy channel", and if the channel or the channels less interfered of the previously filled in table cannot be activated (for example due to asynchronicity of radio scanning on the interactive unit) within the following three DECT frames, the radio unit will be authorised to use bearer Y.

[0024] According to an embodiment the listening may happen in time slots where the synchronisation did not take place, an equivalent situation to the missed recognition of the synchronism word defined in the DECT standard.

[0025] The request/negotiation with the interactive radio unit of the new bearer will occur in one of the following ways.

A) DUPLEX TYPE BEARER X

[0026] With reference to Fig. 5 depicting a possible scenario of messages for the switching from the duplex bearer X into the duplex bearer Y, the requiring radio unit sends to the interactive radio unit, on the bearer X and in the own transmission half frame immediately following to the listening/choice of the bearer Y, a message requiring the activation of the bearer Y. The interactive radio unit confirms the use of the new bearer sending on the bearer X, and in the own transmission half frame immediately following the reception of the request message, a specific confirmation message. From this point forward both radio units will communicate on bearer Y instead of bearer X. According to an alternative solution the confirmation message may be sent on the new bearer Y instead of bearer X as specified before.

[0027] If the request is not followed by a confirmation, the requiring radio unit may once again transmit the request of bearer Y on bearer X; if it still does not receive confirmation/response, it will be opportune to scan a new radio bearer (for example a new frequency on the same time slots of the bearer X). If bearer X is belonging to a multibearer connection, the negotiation protocol of the new bearer Y may take place on another bearer of the same connection, which will be called bearer Z, where the connection quality is good.

B) BEARER X OF THE DOUBLE SYMPLEX TYPE

[0028] As remembered before, a double simplex bearer always belongs to a multibearer connection com-

prising at least a duplex bearer. Therefore in this case the negotiation protocol of the new double simplex bearer Y may take place on a duplex bearer, called here for convenience bearer Z, of the same connection. Fig. 6 reports a possible scenario of messages for the switching from the double simplex bearer X into the double simplex bearer Y using the duplex bearer Z where bearers X, Y and Z belong to the same multibearer connection. The example reports the case where the request and confirmation messages of the new double simplex bearer are transported on a duplex bearer of the same connection.

[0029] In order to further optimise the change times of the bearer, the conditions of synchronism loss on bearer X may be used by the requiring radio unit to monitor in the same time slot new frequencies (i.e. the bearers Y).

[0030] Turning back to the more general case, when the radio unit which wants to operate the bearer change has at its disposal two receivers, the listening of a new frequency on the current bearer may take place without interrupting the communication in progress. This makes it possible to substitute the bearer of the seamless type or without data loss.

[0031] In particular, according to the invention, the operation of listening to a new frequency on at least one of the time slots used in reception, with the purpose to identify a second not interfered bearer Y, and to define an interruption of the established communication on said first interfered bearer X, will be preferentially carried out by the one of the two transceiving devices in that inactive time slot.

[0032] The remaining operations such as:

- sending from the requiring radio unit to the interactive radio unit a request message for the activation of said second bearer Y;
- transfer of all other communications between both radio units from said first bearer to said second bearer Y as soon as the requiring radio unit receives a specific confirmation message by the interactive radio unit for the use of the second bearer Y;
- return to the listening step if said confirmation message is not received, are carried out by the other transceiver (in that moment occupied in an other communication on bearer X) with the consequent advantage to carry out the transfer of the communication from the first bearer X to the second bearer Y without an interruption of the communication, or with seamless modality.

[0033] The method according to the invention makes it possible to obtain the following advantages:

- bigger facility in the selection of a new radio bearer;
- smaller waste of the radio resources and therefore minor electromagnetic interference;
- bigger rapidity in the substitution of a radio bearer and therefore reduction of the deterioration time of a communication in progress;
- reduction of the collisions and consequent increase of the capacity of the system according to the invention.

[0034] Although the invention has been described with particular reference to a preferred embodiment, it will be evident to those skilled in the art, that the present invention is not limited thereto, but further variations and modifications may be applied without departing from the scope thereof. It is thus contemplated that the present invention encompasses any and all such embodiments covered by the following claims.

Claims

1. Method for the change of a radio bearer in a digital telecommunication system comprising a radiomobile unit (PP) and a fixed unit (RFP) in connection with each other on at least a radio bearer and when one of said radio units (PP or RFP) detects a bad quality of the connection established on a first radio bearer (X), it starts off a procedure for the change of such first interfered radio bearer (X), characterised in that said method provides for the execution in sequence of the following steps:
   a) listening of a new frequency on at least one of the time slots used in reception, for the purpose of identifying a second not interfered bearer (Y) and of defining an interruption of the communication established on said first interfered bearer (X);
   b) sending from the requiring radio unit to the interactive radio unit a message requiring the activation of said second bearer (Y);
   c) transfer of all other communications between both radio units from said first bearer to said second bearer (Y) as soon as the requiring radio unit receives a specific confirmation message by the interactive radio unit for the use of the second bearer (Y);
   d) return to the listening step if said confirmation message is not received.
2. Method according to claim 1, characterised in that said request message will be sent on said first bearer (X).
3. Method according to claim 1, characterised in that said request message will be sent on the second bearer (Y).
4. Method according to claim 1, characterised in that said confirmation message will be sent on said first bearer (X).

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5. Method according to claim 1, characterised in that said confirmation message will be sent on said second bearer (Y).

6. Method according to the claims from 1 to 5, characterised in that step b) will be repeated at least one time before going over to step d).

7. Method according to the previous claims, characterised in that step b) is preceded by a test that said second bearer(Y) does not belong to a previously filled in table of channels considered to be interfered.

8. Method according to claim 7, characterised in that step b) is preceded by a check that other less interfered channels of said table cannot be activated.

9. Method according to the previous claims, characterised in that, if said first interfered bearer (X) belongs to a multibearer connection and is of the double simplex type, the negotiation protocol of the new bearer Y (step b), c)) takes place on at least one of the bearers (Z) of the duplex type of the same connection.

10. Method according to the previous claims, characterised in that said activation request message will be sent on the used bearer (X) and in the own transmission half frame immediately following to the listening/choice of the found bearer (Y).

11. Method according to the previous claims, characterised in that said confirmation message is sent on said first bearer (X) and in the own transmission half frame immediately following the reception of said request message.

12. Method according to the previous claims, characterised in that said listening step occurs in the time slots where the synchronisation did not happen.

13. Method according to the previous claims, characterised in that said radio units (PP, RFP) are provided with a double transceiving device and in that the listening of a new frequency described in the above-mentioned step a) is carried out by the inactive one in that moment of the said two transceiver devices, while the remaining steps b), c), d) are carried out by the other transceiver.

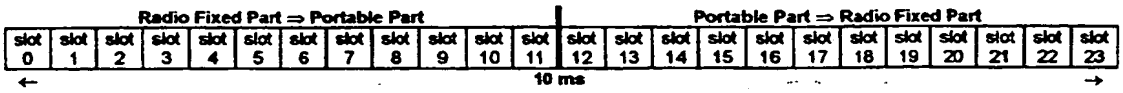


Fig. 1

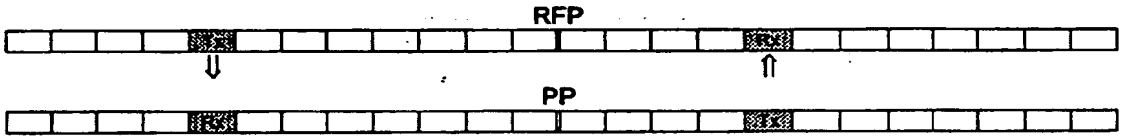


Fig. 2

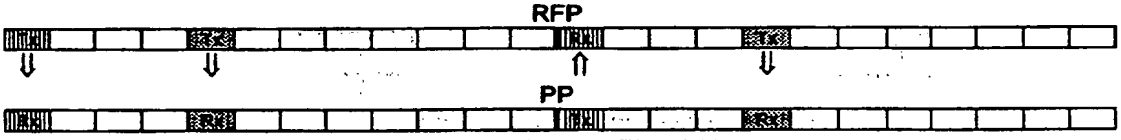


Fig. 3

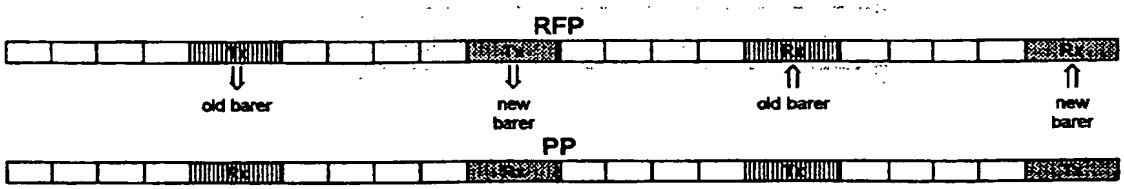


Fig. 4

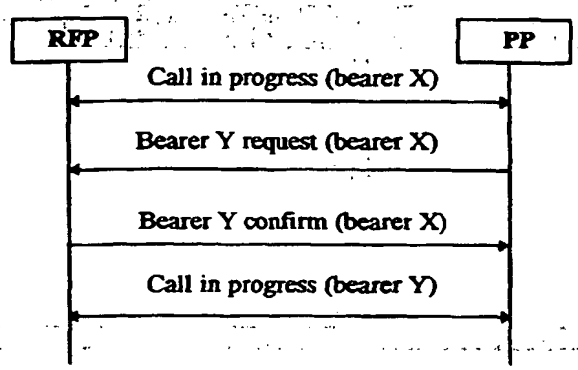

RFP
PP
Call in progress (bearer X)
Bearer Y request (bearer X)
Bearer Y confirm (bearer X)
Call in progress (bearer Y)

Fig. 5

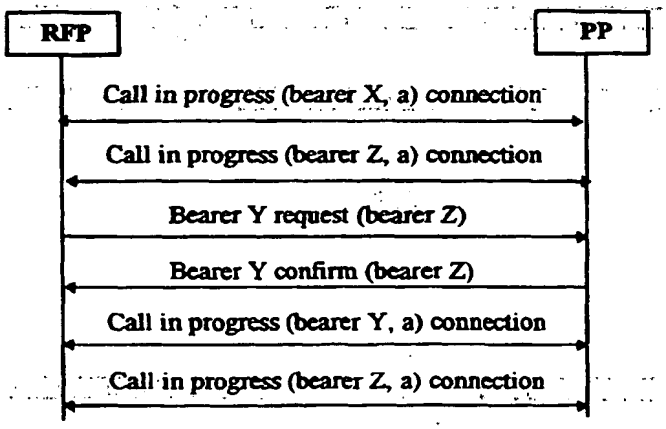
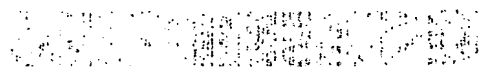

RFP
PP
Call in progress (bearer X, a) connection
Call in progress (bearer Z, a) connection
Bearer Y request (bearer Z)
Bearer Y confirm (bearer Z)
Call in progress (bearer Y, a) connection
Call in progress (bearer Z, a) connection

Fig. 6



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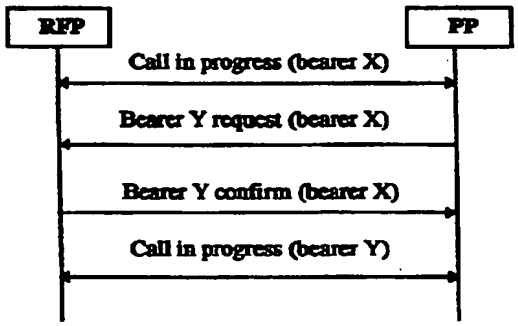

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 99 10 1190

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US 5 613 203 A (KUMAR VINOD ET AL) 18 March 1997 (1997-03-18) * column 4, line 6 - line 40 *	1	H04Q7/38
A	EP 0 722 258 A (NOKIA MOBILE PHONES LTD) 17 July 1996 (1996-07-17) * column 1, line 10 - line 18 * * column 3, line 28 - column 7, line 17 *	1	
D,A	EP 0 576 079 A (KONINKL PHILIPS ELECTRONICS NV) 29 December 1993 (1993-12-29) * the whole document *	1	
A	BONZANO L ET AL: "DECT performance in the wireless PBX application" ICC '93 GENEVA. IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS '93. TECHNICAL PROGRAM, CONFERENCE RECORD (CAT. NO.93CH3261-5), PROCEEDINGS OF ICC '93 - IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS, GENEVA, SWITZERLAND, 23-26 MAY 1993, pages 1269-1273 vol.2, XP002136277 1993, New York, NY, USA, IEEE, USA ISBN: 0-7803-0950-2 * page 1269, right-hand column, line 15 - page 1270, left-hand column, line 5 *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6) H04Q
A	EP 0 749 256 A (NIPPON ELECTRIC CO) 18 December 1996 (1996-12-18) * abstract *	1	
E	EP 0 895 437 A (CANON KK) 3 February 1999 (1999-02-03) * column 13, line 14 - column 15, line 40 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 April 2000	Baas, G

CATEGORY OF CITED DOCUMENTS

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20-04-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5613203 A	18-03-1997	FR 2711867 A	05-05-1995
		AU 680545 B	31-07-1997
		AU 7588794 A	18-05-1995
		EP 0651587 A	03-05-1995
		FI 945040 A	29-04-1995
		NZ 264725 A	26-11-1996
EP 0722258 A	17-07-1996	GB 2297014 A	17-07-1996
		CA 2166831 A	11-07-1996
		JP 8251650 A	27-09-1996
		US 5825757 A	20-10-1998
EP 0576079 A	29-12-1993	DE 69324851 D	17-06-1999
		DE 69324851 T	25-11-1999
		ES 2133352 T	16-09-1999
		JP 6078360 A	18-03-1994
		SG 48384 A	17-04-1998
		US 5416778 A	16-05-1995
EP 0749256 A	18-12-1996	JP 2713240 B	16-02-1998
		JP 9009327 A	10-01-1997
		CN 1146699 A	02-04-1997
		SG 64390 A	27-04-1999
		US 5764631 A	09-06-1998
EP 0895437 A	03-02-1999	JP 11046174 A	16-02-1999
		CN 1220569 A	23-06-1999

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